

It is remarkable how very closely the measurements of the body of this animal agree with those given by Dr. Hector, in the 'Trans. N.Z. Institute,' vi. p. 85, of a porpoise from Cook Straits that he refers to *Delphinus Forsteri*. The Dusky-Sound specimen, however, differs considerably both in colour and form from the figure of *D. Forsteri* in the 'Voyage of the Erebus and Terror;' while Dr. Hector says that the Cook-Straits specimen "does not differ sufficiently from that copied last year after Forster to make it worth reproduction."

The skeleton is being prepared for the Otago Museum.

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XLIX.—*On the Geological Structure of the Amazons Valley.*  
By Professor JAMES ORTON\*.

THE valley of the Amazons is a very shallow basin of vast extent and of an oval shape, with the small end pointing eastward. Between December and June a large part of it resembles a huge undrained swamp, and people sail half the year above districts where for the other half they walk. Were the forest removed from the Lower Amazons, a great mud flat would be exposed (lower than the island of Marajó), threaded by a network of deep channels, partially covered by every tide, and deluged by the annual flood. From the marked feature (first noticed by Chandless) that the tributaries enter the main stream at a very acute angle, and have exceedingly tortuous courses, it is inferred that the rest of the valley is a nearly level plain gently inclined from west to east, and with very little slope on either side toward the centre of drainage.

Between Borja and Pará, a distance of 29°, the inclination is only 500 feet. A section from Exaltacion, on the Upper Madeira, which has the same altitude as Borja, to San Carlos, on the Upper Negro (which is elevated only 212 feet above the Atlantic), would show a depression at Fonte Boa, on the Amazons, of only 150 feet in 1000 miles. The Negro is a sluggish stream (San Carlos being on a level with Tabatinga); the Napo is more rapid; and the Pastássa is a torrent. In the last thousand miles, the Madeira descends 430 feet, the Purús 225, and the Ucayali 400; while the Huallága has probably a swifter current than any of the southern affluents.

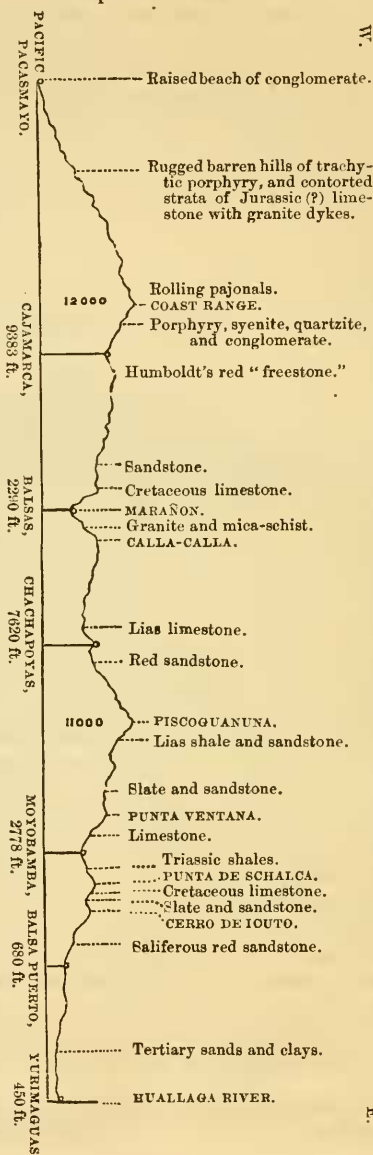
The basin of the Great River is principally enclosed by the

\* Communicated by the Author, being Chapter XLI. of the forthcoming new edition of his work on the Andes and the Amazons.

sedimentary slopes of the Andes and the metamorphic regions of the Casiquiare and Central Brazil.

As the rise of the Andes was the creation of the Amazons, the study of the mountain should precede that of the river; indeed the structure of the basin cannot be understood without a knowledge of the "rim." The geology of the Andes is not sufficiently advanced to warrant a classification of the ranges with respect to their periods of elevation. Yet it is very probable that the coast Cordillera was the first to emerge, and very certain that the eastern did not reach its present elevation until after the Cretaceous age. The characteristic rocks of the maritime range are trachytes and porphyries; of the oriental, sandstones and slates.

The annexed profile of the Andes of Northern Peru gives the relative heights of the ranges and the main formations. I found no fossils in the Pacasmáyo beach; but at Payta, further north, there are many—among them *Turritella patagonica*, Sow. (which Darwin found also on the coasts of Patagonia and Chile), and *Pecten modisonus*, Say, and *Crepidula fornicata*, Say, identical with Miocene species on the east coast. The beach was therefore raised in late or post-Tertiary times; and there is evidence that a



subsidence has taken place since the Conquest\* ; for an Inca-rial road, with side-walls intended to run along the coast, starts from Pacasmáyo, and ends in the sea some three miles south.

The western Cordillera is doubtless Mesozoic, the Pacific side being probably Jurassic, as in Southern Peru, and the oriental side Cretaceous. From the slope facing Pacasmáyo I obtained Jurassic Cardiums and Ostreas, and an Ammonite resembling *A. Murchisoni*. Above Balsas, near Tomependa, Humboldt found and Von Buch determined Echini, Isocardias, Pectens, Ostreas, and Ammonites of Cretaceous age; and similar forms were discovered by Raimondi below, within the department of Ancachs. Half a day's journey west of Chachapoyas is a highly fossiliferous limestone, abounding with Ammonites and Pectens, which, according to Professor Hyatt, are Liassic†. The fossils are most common along the left bank of the Utcubamba, near Tingo. Some of the Ammonites are a foot in diameter. Belemnites and Starfishes have also been found further down the Utcubamba, near Bagua; and at San Carlos is an extensive salt deposit. The dark-brown shale near the summit of Piscoguañuna, dipping strongly to the eastward, contains numerous Middle-Lias Ammonites. The rapid Cachiyacu, tearing its way down from the Punta de Schalca, brings along many Ammonites and Brachiopods of Cretaceous

\* I have elsewhere called attention to the singular fact that every successive measurement of the Andes gives a reduced elevation, tempting one to believe that either the chain is sinking or the atmospheric pressure increasing. Thus, Humboldt (1803) made the altitude of Quito 9570 feet; the writer (1867), 9520; Reiss and Stübel (1870), 9350. Pichincha, according to Humboldt, is 15,922 feet; according to the writer, 15,827; according to Reiss and Stübel, 15,704. In 1827 Pentland very carefully estimated the altitude of Lake Titicaca at 12,795 feet; and Friesach, in 1858, determined it to be 12,630; but the recent railway-levellings from the coast make it only 12,493.

† The following is an abstract of Professor Hyatt's paper presented to the Boston Society of Natural History, January 20, 1875, entitled "Notice of Jurassic and Cretaceous Ammonites collected in South America by Professor James Orton, with an Appendix upon the Cretaceous Ammonites of Professor Hartt's collection":—

"JURASSIC AMMONITES (Lias):—*Arnioceras ceras*, Agassiz (*Amm. ceras*, Giebel): under this name I have been obliged to describe several badly preserved specimens, which resemble in their characteristics very closely this well-marked species of the Lower Lias: *loc. Piscoguañuna*, Northern Peru. *Arnioceras miserabilis?*, Hyatt (*Amm. miserabilis?*, Quenst.): *loc. Piscoguañuna*. *Caloceras Ortoni*, Hyatt: this new species is closely allied to *Amm. sironotus*, Quenst., also a Liassic species: *loc. Tingo*, Northern Peru. *Phylloceras Loscombi*, Hyatt (*Amm. Loscombi*, D'Orb.): this is another Lias form, probably Middle Lias, from the same locality. *Perisphinctes anceps*, Waagen: this species indicates the presence of the higher divisions of the Jura, the Lower Oxford of Oppel, perhaps

age. This Punta, the saddle which divides the rivers Cachi-yacu and Mayo, continues northward; and through its limestone strata the Marañon has cut the Pongo de Manseriche. The limestone at the Pongo yielded me a *Protocardia*, a linguiform *Ostrea*, and an *Exogyra* of Cretaceous type. All the Pongos on the Upper Marañon are made through limestone mountains. The Punta de Schalca is also a prolongation of the calcareous range which crosses the Huallága at the Pongo de Aguirre. It is probable therefore that this western wall at the head of the Amazons valley is of Cretaceous age.

The Cerro de Icuto is flanked on the east with saliferous red sandstone. It contains the valuable salt-mines of Cachi-puerto, on the Cachi-yacu; and without doubt the salt-hills of Chasuta and Pilluana on the Huallága belong to the same formation, as also the gypsum-beds in the elevated ridge separating the Huallága from the Ucayali. The Cerro de Sal, further south, near the head of the Pachitea, may likewise be contemporaneous\*. The Icuto rock is unfossiliferous, and I could not find its relation to the Schalca limestone. The great Moyobamba valley, enclosed between the Schalca and Piscoguañuna ranges, is lined with friable shales of divers colours (red, yellow, purple, blue, and black), with overlying soft white sandstone. Drs. Raimondi and Spruce refer this to the Triassic. Near Tarapoto, where the shales contain Ammonites of immense size, there are jointed columns of trap-rock and cliffs of white salt.

In crossing the Andes in the latitude of Lake Titicaca eastward, we first find Oolitic formations largely covered with intrusive rocks. After passing the summit of the coast Cordillera

the Kelloway division of that formation: *loc.* Compuerta, near Lake Titicaca, fifty miles north-west of Puno, altitude of 13,500 feet. *Stephanoceras macrocephalum*, Waagen: the identity of this, as well as the former, with European species cannot be doubted; it indicates the same division of the Jura: *loc.* Caracolis, near Lake Titicaca. It is probable that the whole series of Jurassic rocks exist in Peru and Bolivia.

“CRETACEOUS AMMONITES.—The remarks upon the specimens in this division are interesting simply because they have furnished me the means of establishing a new genus to include the forms which have hitherto been regarded as Cretaceous Ceratites. This genus I have called *Buchiceras*, in honour of the great German geologist Leopold von Buch. It includes the following species:—*B. bilobatum*, Hyatt, n. sp., *loc.* Punta de Schalca, Northern Peru; this would be generally supposed to be identical with the *Anm. syriacus*, Von Buch, but the comparison of authentic specimens shows specific differences; *B. serratum*, Hyatt, n. sp., *loc.* Cachi-yacu, Northern Peru, doubtless washed down from the Punta de Schalca.”

\* The gorge of Tunkini on the Upper Ucayali is described by Castelnau as “freestone.”

we have purely sedimentary strata, contorted, but dipping easterly—conglomerate, sandstone, slate, and Jurassic limestone. Then follow, in succession :—Triassic beds (remarkably like those in the Moyobamba valley, capped with white sandstone, and broken by protruding igneous rocks); Carboniferous, at the south end of the lake, and reappearing east of Cochabamba on the headwaters of the Chapara; and the Devonian and Silurian, forming the mass of the high Andes.

If now we examine the valley of the Amazons, we shall be struck with its remarkably uniform character, such as is presented by no other region on the globe of equal area. From the Andes to the Atlantic, and from the Falls of the Madeira to the Orinoco, scarcely any thing is visible but clays and sandstones.

The fundamental rock is metamorphic, chiefly gneiss and granite. It is exposed at the falls of the tributaries, especially on the Madeira; it is greatly disturbed, and frequently broken through by porphyritic dykes. The granite contains little mica and much quartz. The valley is bounded on the north and south by immense metamorphic areas. The low watershed between the Amazons and Paraguay is covered with Tertiary beds; but the still lower region of the Upper Rio Negro is one great undulating sheet of granite and gneiss completely denuded of the stratified rocks that once overlay it, save here and there a thin covering of white sand and red loam filling the hollows, and abrupt peaks that suddenly rise from the plain.

Silurian formations are rarely visible. The gold and topaz-bearing rocks of Minas Geraes probably belong to this age; but they are greatly altered. In the Bolivian Andes, facing the Madeira valley, is an extensive development of Silurian slates and sandstones. The only undoubted Devonian formation in the valley is the plain north of the Serra of Ereré, discovered by Hartt.

The horizontal limestone strata at Itaituba on the Tapajos, and on the Trombetas across the Amazons, abound with Brachiopods of the Coal-measures. D'Orbigny and Forbes have pointed out isolated Carboniferous deposits in the Titicaca basin and near Santa Cruz, on the Mamoré. From the Pichis, which flows directly from the Cerro de Sal (a spur of the eastern Cordillera), I obtained several fossils of limited vertical range which go to show that the Pichis, Bolivian, and Itaituban beds are identical. The Pichis, Titicaca, Oruro, and Guaco (province of San Juan) deposits lie in the same line, north-west south-east, along the Andes. The altitude of the Tapajos beds is 125 feet, of the Pichis over 700 feet, of the

Titicaca 12,500 feet; and Raimondi has found Carboniferous rocks on the Apurimac at the height of more than 14,000 feet. It is evident that through the Palæozoic ages at least the basin of the Amazons was an open sea\*.

No Mesozoic rocks are visible east of the Andes, except the Cretaceous conglomerate found by Chandless on the Upper Purús, which, however, was evidently washed down

\* A pebbly bottom is first struck in ascending the Ucayali about fifteen miles up the Pachitea. Now and then bluffs of yellowish-grey sandstone abound on the Pachitea; but the Ucayali, for 700 miles from its mouth, flows through a vast pampa, overflowed in the rainy season. The rocky bed of the Pichis (lat. 10°, long. 75°) is filled with fragmentary fossiliferous limestone of an ash-grey colour. At Puerto Tucker, the highest point navigable in canoes, lofty mountains are seen about seven miles distant, extending east and west. I am indebted to the Hydrographical Commission for specimens from the bed of the Pichis. Among them are two corals, which I have submitted to Professors Hall and Pourtales. One is cyathophylloid, having the structure of *Amplexus*; but it is compound. The other has the aspect of *Syringopora*, and may be an *Edriophyllum* of small size. The evidence is in favour of their Carboniferous age. The following note on the mollusks is by Mr. Orville A. Dewey, of Cornell University:—"On his return from Peru in 1874, Prof. James Orton submitted to me for examination a piece of fossiliferous limestone from the Pichis river. The mass was a waterworn pebble of dark-blue stone, scarcely larger than one's fist. The fossils being silicified, the specimen was treated with acid, and a number of species of Brachiopoda obtained. The only other fossil was a slender ramose coral or Bryozoa, which, being imperfectly silicified, could not be obtained for identification. The number of individuals and species occurring in so small a mass indicate an exceedingly rich fauna in the locality. The following are the species determined:—

"*SPIRIFERA CAMERATA*, Morton: this widely distributed species is represented by several specimens, one of which is of considerable size, and shows unmistakably the characteristics of the species; the fasciculated arrangement of the ribs, though distinct, is not strongly marked; and in this as in other respects it agrees with the forms found on the Tapajos. The occurrence of this form in the Andes strengthens the view which I had taken in my paper on the Brazilian Carboniferous Brachiopods (Bull. Cornell Univ. vol. i.), that *S. condor*, D'Orb., from Lake Titicaca is identical with the North-American species. *SPIRIFERA* or *SPIRIFERINA*, sp.: there is also a fragment with rather coarse simple ribs not recognizable specifically; the aspect is that of a *Spiriferina*; but no puncta have been observed. *SPIRIFERA PERPLEXA*, M'Chesney: a single dorsal valve is referred to this species. In the paper above cited I have endeavoured to show that this well-known and widely distributed American form is distinct from the European *S. lineata*, Martin, to which it has usually been referred. An exceedingly small specimen, presenting the characters of a smooth *Spirifera*, is probably the young of this species or of *S. planoconvexa*, Shumard. *EUMETRIA MORMONII*, Marcou (*Retzia punctulifera*, Shumard), is by far the most abundant species, being represented by ten or a dozen specimens in the rock examined; one of these is figured on pl. viii. fig. 8 in my paper referred to. *TEREBRATULA BOVIDENS*, Morton(?): a crushed specimen agrees perfectly with Morton's species from Missouri in the characters of the beak and in general form, as far as the latter can be observed. This species is known from two Bolivian localities. Salter identified it.

from a higher locality further south\*. The Andean region was covered by the Jurassic sea, and was afterward elevated (in Northern Peru) 11,000 feet. The moment the Andes began to rise, the topography of the Amazons valley was fore-shadowed. The superficial Cretaceous strata up the Paramapura, at the Pongo de Manseriche, and from Tomepanda up the remarkable longitudinal valley of the Upper Marañon to Balsas, into the department of Ancachs, would indicate that so much at least of the great river began to exist in the early Tertiary. Without doubt, during the Cretaceous period the Atlantic and Pacific were continuous oceans, flowing over not only the Panama isthmus, but also over all Equatorial America, save a few islands and reefs. We are not surprised therefore to find the same Cretaceous (and even Miocene) species on both sides of the Andes†.

The vast basin (whether Carboniferous or Cretaceous I will not say) formed by the rise of the Andes and the metamorphic regions on the north and south received an immense sheet of coloured clays, sands, and sandstones. This deposit, unique in its extent and origin, is known as the Amazonian Tertiary formation. It was the sediment of a brackish Mediterranean, or of a quiet lake to which brackish water had occasional access. The argillaceous and loamy beds are universal; the sandstone has been reduced by subsequent denudation, and is now nearly confined to the Lower Amazons‡. Excepting this

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under the name of *T. millepunctata*, among some specimens brought from Santa Cruz by Mr. Cummings (Quart. Journ. Geol. Soc. vol. xvii. p. 50); and Toula describes an apparently identical form from Cochabamba as *T. Hochstetteri* (Proc. Vienna Acad. lix.). RYHNCHELLA or CAMAROPHORIA, sp.: a small specimen; ovate, about as long as wide; ventral valve depressed, convex, with a broad shallow sinus extending but little beyond the middle, and marked by two rounded ribs; dorsal valve gibbous; surface smooth. Should this prove to be new, I would suggest the name of R. (or C.) ORTONII. Of these species, *S. camerata*, *S. perplexa*, and *E. Mormonii* occur on the Tapajos in beds equivalent to the North-American Coal-measures, of which the same species, with *T. boridens*, are characteristic. I have endeavoured to show (Bull. Cornell Univ. vol. i. part 2, p. 6) that the fossils found in various Bolivian localities belong to the same division of the Carboniferous age. The existence of a Carboniferous basin in Peru quite widely removed from the Titicaca basin on the south, and from the Tapajos basin on the east, is an exceedingly interesting point in South-American geology.

\* Dr. Galt brought an Ammonite from the mouth of the Pichis on the Pachitea (Upper Ucayali), which appears to be Cretaceous. It was probably washed down from the south.

† Mr. Bland informs me, after an examination of my land-shells, that the general aspect of the living *Bulimi* from the Peruvian Andes is remarkably like the Lower Californian.

‡ Vesicular ferruginous sandstone occurs far up the Madeira and Negro. I am not aware of its existence in any part of the Marañon region.

sandstone, the material is so thoroughly comminuted that a pebble is a rarity. The Marañon Indians, upon returning from up the Ucayali and other tributaries, bring home rocks to sharpen their knives. I have seen, however, concretions, nodular and stalactiform, strikingly similar to the marly concretions noticed by Darwin in the Pampean mud.

Previous to the expedition of the writer across the continent in 1867, this vast homogeneous formation along the great river had not yielded a single fossil. In the words of Professor Agassiz, "Tertiary deposits have never been observed in any part of the Amazonian basin." And it was on this negative evidence mainly that the distinguished naturalist hazarded the conjecture that the formation was drift\*. But the banks of the Marañon prove to be highly fossiliferous. At Pebas, near the mouth of the Ambiyacu, I discovered in one of the beds of blue clay, 12 feet below the surface, a multitude of fossil shells. Below this bed is a seam of lignite, and then another layer of fossils. I engaged Mr. Hauxwell, an English collector, to search for other localities; and in 1870 he reported a large deposit on the south side of the Marañon, below Pebas, at Pichana. The shells were larger and more plentiful than at Pebas, and were found from 6 to 20 feet beneath the soil. In revisiting the Amazons in 1873, I discovered at Iquitos, more than a hundred miles west of Pebas, a still more prolific bed†. Here the shells occur above, below, and in the lignite band, beginning about 20 feet from the surface. They are best exposed about two miles below the town. A well dug at Iquitos shows:—first, 7 feet of variegated clays, 9 feet of fine

\* The history of the attempt to find the traces of glaciation in this equatorial region is short. The Cambridge professor, who had berated other naturalists for theorizing without facts, entered the mouth of the Amazons for the first time in his life with the confidence of a prophet, foreordaining boulders, moraines, striæ, and all the other appurtenances of a gigantic glacier. All proved to be imaginary; yet the chief and his satellites stoutly kept their original faith. Professor Hartt, after propounding several modifications, the last one being the possible glacial origin of the superficial layer (to which the Pebas shells had driven him), finally owns that, "having no evidence whatever of the former existence of glaciers in the Amazons, the question of the glacial origin of the valley need not be raised." For evidence against the supposition of a glacial epoch at the Equator, see *Ann. & Mag. Nat. Hist.* 1871, vol. viii. p. 297. Keller, in his late exploration of the Madeira, searched diligently for erratic boulders; but not a trace of the "foundlings" could be discover. "I never believed for a moment," writes Mr. Darwin, "in Agassiz's idea of the origin of the Amazonian formation."

† It is very singular that Castelnau and Herndon overlooked the shells at Pebas, since they are plainly exposed—and still more strange that Mr. Steer, who examined the beds at Pebas and Pichana in 1871, found nothing at Iquitos, where I found shells even more abundant than below. All the known localities were discovered by myself and by Mr. Hauxwell, under my instructions.



sand; next, several feet of pebbles; and then blue clay containing shells. From the collections made at these localities, the following thirty species have been determined:—

## BIVALVES.

*Pachyodon carinatus*, Conrad.  
 — *obliquus*, Gabb.  
 — *tenuis*, Gabb.  
 — *erectus*, Conrad.  
 — *cuneatus*, Conrad.  
 — *ovatus*, Conrad.  
 — *cuneiformis*, Conrad.  
 — *dispar*, Conrad.  
*Dreissena scripta*, Conrad.  
*Anodon Batesii*, Woodward.  
 — *pebasana*, Conrad.  
*Triquetra longula*, Conrad.  
*Ostomya papyria*, Conrad.  
*Haplothærus capax*, Conrad.

## UNIVALVES.

*Isæa Ortoni*, Gabb.  
 — *linteria*, Conrad.  
*Liris laqueata*, Conrad.  
*Ebora crassilabra*, Conrad.  
*Nesis bella*, Conrad.  
*Neritina Ortoni*, Conrad.  
*Dyris gracilis*, Conrad.  
*Hemisinus sulcatus*, Conrad.  
 — *Steerei*, Conrad.  
*Iquitosia tuberculifera*, Conrad\*.  
*Pachytoma tertiaria*, Conrad.  
*Toxosoma eborea*, Conrad.  
*Cirrobasis venusta*, Conrad.  
*Liosoma curta*, Conrad.  
*Cyclocheila pebasana*, Conrad.  
*Bulimus linteus*, Conrad.

These interesting fossils have attracted much attention by their extraordinary character, and by the light which they throw upon the largest continuous Tertiary formation in the world. All the species and twelve of the genera are extinct. The impalpable clay in which they were imbedded was admirably fitted for their preservation. Some have retained their colours and epidermis; and the bivalves generally occur with the valves united and closed. They exist also in such vast numbers that they must have lived and died on the spot. The bivalves are most abundant at Pichana, and the univalves at Iquitos—localities at least 150 miles apart: the former may be the lower stratum, and the other the upper. The *Hemisinus* is particularly abundant at Iquitos, and very rare in the Pebas district. Mr. Gabb led me astray in saying that these shells are marine. Most of them are freshwater; many are estuarine (but might have lived in fresh or brackish water); and a few are terrestrial. Mr. Conrad, who examined my large collections, and is better prepared to speak than any other palæontologist, considers the beds *Eocene*†.

\* This beautiful and characteristic shell was originally described, in *Proceed. Acad. Nat. Sci. Philad.* vol. xxvi., as a *Hemisinus*; but Mr. Conrad has since decided that it belongs to a new genus, distinguished by its high *Melania*-like spire and short patulous aperture. "Subulate, subturreted; whorls numerous, spirally ribbed; aperture short, oval; columella regularly arched, solid, subtruncated at base; outer lip regularly curved." The name is derived from Iquitos, Peru, where it is very abundant. *Hemisinus* and *Triquetra* are characteristic genera of South-American rivers.

† *Per contra*, Professor Hartt, who has never seen the Marañon, decides "that it was in the latter part of the stage of growth of the basin that the clays of the Upper Amazon were deposited and the Pebas shells lived. This appears to have been near the close of the Tertiary."

I am not prepared to give the vertical or horizontal distribution of these fossils. So far as visible at low water, they appear to range over 20 feet of depth, coming nearer to the surface at Pebas than at Iquitos; but the main layer lies nearly parallel with the level of the river, which falls about 40 feet between the two places. They occur on both sides of the lignite, which is traceable from Tabatinga to the Huallága. The shell-bed must extend far west of Iquitos; and in my last expedition I procured a mass of yellow clay, containing the "Pebas shells," from a point several hundred miles up the Ucayali: the precise locality I cannot give, as I did not visit it. Evidently this Tertiary basin is not so contracted as the glacialists have tried to make it. Dr. Galt brought from the Pachitea (near the junction of the Pichis and Palcazu) a beautiful *Ostrea*, which Conrad calls *O. callacta*, and says it is a Tertiary form, and was filled with a light-coloured clay strikingly similar to that of the Pebas beds\*. Mastodon remains have been found near Moyobamba; and silicified wood is occasionally seen in the hands of the Marañon Indians.

It is evident that such an even sheet of fine earth could not have been spread over such a vast area by streams from the rising Andes; it must be the deposit of a quiet inland lake. It is evident that the Amazons estuary extended further west than now, the result of a gentle oscillation: a subsidence of one hundred feet at Tabatinga would make the tides felt on the Marañon. It is evident that the condition of things in the Brazilian Amazons, both during and after the deposition of the formation, was different from that in the Marañon region. If there is any difference in age, I should give the priority to the latter. It is evident that the Andes did not reach their present altitude until after the deposition of the Amazonian formation,—though it was a slow movement, in mass; for the beds are nowhere unequally tilted or dislocated. The clay-beds ascend with gentle inclination the eastern slope, being visible far up the Napo, Pastásá, and Huallága. Balsa Puerto, 3° 15' west of Iquitos and 400 feet higher, stands on a thick bed of red, yellow, and white clays, resting on a soft slate, dipping easterly†. By the continued rise of the Andes, the great equatorial lake, already shallowed by sediment, was drained, leaving only a network of rivers, igarapes, and lagunes.

Poughkeepsie, New York,  
September 22, 1875.

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\* In the ferruginous clay at Villa Bella, Lower Amazons, I found imbedded a little shell, which Conrad refers to *Acicula*.

† At the head of the Napo and Pastásá the Andes begin with a soft slate of great thickness, overlying mica-schist and trachyte.